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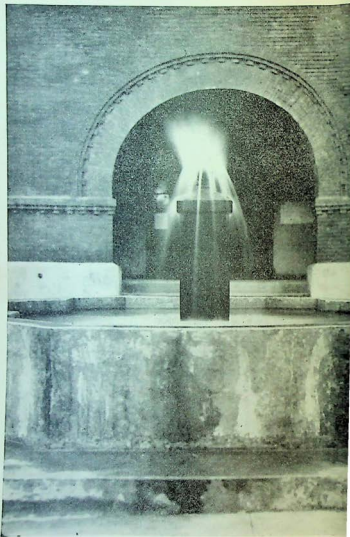
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GROUND-WATER RESOURCES
OF
GRANT AND LA SALLE PARISHES
LOUISIANA

by
John C. Maher

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Artesian well at Colfax flowing salt water and gas. The gas is ignited the appearance of burning water.

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***Geology of Iberia Parish,**

1931, Geological Bulletin No. 1

By Henry V. Howe and Cyril K. Moresi

***Foraminifera of the Jackson Eocene,**

1932, Geological Bulletin No. 2

By Henry V. Howe and William E. Wallace

***Geology of Lafayette and St. Martin Parishes,**

1933, Geological Bulletin No. 3

By Henry V. Howe and Cyril K. Moresi

Louisiana Sabine Eocene Ostracoda,

1934, Geological Bulletin No. 4

By Henry V. Howe and Julius B. Garrett, Jr.

Louisiana Jackson Eocene Ostracoda,

1935, Geological Bulletin No. 5

By Henry V. Howe and Jack Chambers

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By R. J. Russell, H. V. Howe, J. H. McGuirt, C. F. Dohm,
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William Campbell Steere

* Out of print.

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1938, Geological Bulletin No. 13
By H. V. Howe, R. J. Russell, F. B. Kniffen, J. H. McGuirt,
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- Geology of Caldwell and Winn Parishes,**
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By R. E. Marsh
- Ground-Water Resources of Rapides Parish, Louisiana,**
1940, Geological Bulletin No. 17
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- Geology of Avoyelles and Rapides Parishes,**
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By H. N. Fisk
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By T. P. Woodward, Albert J. Gueno, Jr., and John W. Frink
- Ground-Water Resources of Grant and LaSalle Parishes, Louisiana,**
1941, Geological Bulletin No. 20
By John C. Maher

LETTER OF TRANSMITTAL

University, La.
April 23, 1941.

Honorable Joseph L. McHugh, Director,
Department of Minerals.

Dear Mr. McHugh:

I have the pleasure of transmitting Louisiana Geological Bulletin No. 20 entitled, "Ground-Water Resources of Grant and LaSalle Parishes, Louisiana," by John C. Maher, Geologist-in-Charge of Suboffice of the United State Geological Survey, University, Louisiana. This report has been prepared under the direction of V. T. Stringfield, Geologist, Water Resources Branch of the United States Geological Survey, in cooperation with the Louisiana Geological Survey.

Publication of this report is exceedingly timely, since the demand for ground-water supplies has been greatly stimulated by the present national defense program in Louisiana. It is believed that the facts and data revealed in this bulletin will definitely assist in intelligently securing and developing an adequate ground-water supply in Grant and LaSalle Parishes.

J. HUNER, JR., PH. D.
State Geologist.

GROUND-WATER RESOURCES
OF
GRANT AND LA SALLE PARISHES
LOUISIANA

by

John C. Maher

Assistant Geologist

U. S. Geological Survey

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Baton Rouge, La.

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GEOLOGIC FORMATIONS AND THEIR WATER-BEARING PROPERTIES

Eocene series

Claiborne group

The oldest formations penetrated in drilling water wells in Grant and LaSalle Parishes are those of the lower Claiborne group of the Eocene series. Only two water wells are thought to have been drilled below the Cockfield formation. One of these was the recent test at Montgomery, drilled to a depth of 900 feet before being abandoned. The other was the water well drilled by the Urania Lumber Company at Urania. This well was reported to have been completed at a depth of 1050 feet in a sand about 48 feet thick which yielded gas and brackish water under sufficient pressure to flow at the surface. A comparison with the section penetrated in Theodore Davis et al, W. E. Barrett No. 1 oil test, SW $\frac{1}{4}$ SW $\frac{1}{4}$ sec. 19, T. 9 N., R. 1 E., as published by Fisk (1938, p. 189, 190) leads to the conclusion that the water in the Urania Lumber Company well was from the Sparta sand.

Section of formations penetrated in Theodore Davis et al, W. E. Barrett No. 1, oil test, SW $\frac{1}{4}$ SW $\frac{1}{4}$ sec. 19, T. 9 N., R. 1 E. (Fisk).

Quaternary	Depth in Feet
Prairie member (Pleistocene) water-bearing sands	0- 56
Tertiary	
Eocene	
Jackson group	
Fossiliferous blue clays (Zenoria member)	56- 88
Shales and gumbo of the Yazoo clays and Moody's Branch marl.....	88- 325
Claiborne group	
Cockfield	
Unfossiliferous shales with boulders and some "rock". Gas showing at base.....	325- 801

	Depth in Feet
Cook Mountain	
Fossiliferous sandy clays, interbedded with nonfossiliferous lignitic shales.....	801-1090
Sparta sands	
Nonfossiliferous lignitic sands with some glauconite particles, interbedded with nonfossiliferous clays. Oil and gas show at 1,375 feet. "Dead" oil sand at 1,505 feet....	1090-1545
Cane River	
Very fossiliferous sandy clays.....	1545-1563
Sparingly fossiliferous, glauconitic, sands and clays.....	1563-1597
Very fossiliferous greensands carrying <i>Discocyclus advena</i>	1597-1609
Sparingly fossiliferous glauconitic sand beds	1609-1629
White, coarse sands, pyritiferous, with interbedded brown lignitic shales and sands.....	1629-1645
Sparingly fossiliferous, glauconitic, sands and clays with calcareous "rock" at base.....	1645-1667
Sabine group	
Wilcox	
Nonfossiliferous, pyritiferous, lignitic sands and brown lignitic shales.....	1667-1686

The Sparta sand and the Cook Mountain, as well as the earlier Tertiary strata directly below, are deeply buried in most of the two Parishes. The presence of brackish water in the Sparta at Urania and in the Cockfield at Colfax indicates that these Eocene sediments below the Cockfield probably would yield highly mineralized water in both Parishes. For this reason, discussion of the water-bearing properties of beds below the Cockfield has been omitted from this report.

Cockfield formation. The present day Cockfield was named "Cocksfield" by Vaughan in 1895 (p. 220) for the outcrop at "Cocksfield" Ferry at Petite Ecore. Veatch in 1906 (1906A, p. 38) corrected the spelling to "Cockfield", corresponding to the name of the plantation owners at Petite Ecore.

The Cockfield formation crops out in northern Grant Parish in the vicinities of Montgomery and Packton, and in the northwestern corner of LaSalle Parish (see pl. 1).

It is composed of about 500 feet of light-gray and brown lignitic silty clays, silts, and sands with small lenses of lignite and is characterized by numerous fossil leaves and other plant remains. The type locality of these beds is a steep bluff on the Red River above Montgomery called Petite Ecore. A lignite seam from one to three feet thick and two layers of siltstone are prominent in this section. The following is the section of this locality as described by Fisk (1938, pp. 83, 84) and Huner.

Quaternary materials	Ft.	In.
Gray sandy soil.....		6
Mottled-gray clay lenses in sands and gravels..	2	
Silty clays, with irregular sand beds grading upward into light-brown silts which weather into characteristic pinnacle forms.....	17	6

Cockfield section

Very compact, silty, well-indurated, mudstones grading downward into beds of massive argillaceous siltstone which contain many plant fossils (palm fronds, etc.). The fossiliferous beds are characterized by a sulphur-yellow efflorescence	8	
Dark-gray to black, poorly bedded, lignitic silts interfingering with a thin, lenticular (less than 1 foot to 3 feet thick) seam of peaty lignite....	5-8	
Dark-gray lignitic silts (weathering to light-gray with yellow efflorescence) grading downward into massive, lenticular, siltstone with abundant plant fragments.....	14	
Lignitic clays with poorly defined bedding grading upward into well-defined beds of blocky, somewhat less lignitic, clays and lenticular silty sands.....	24-26	
Black lignitic silts, with twigs, stems, leaf impressions; characterized by yellow efflorescence and interbedded with micaceous fine sands. Lenticular massive siltstones are present in two horizons, each characterized by septarian concretions and locally associated with well-defined cone-in-cone structures. Gypsum crystals are common in the sandier lenses and along bedding planes		
Total maximum exposed thickness of Cockfield formation.....	68	

At Montgomery Landing the transition of the Cockfield into the Jackson is well exposed. A zone of calcareous concretions ranging in size from less than an inch to more than a foot are found here about 25 feet below the base of

the Jackson. The formation of these concretions has been attributed by Fisk (1938, pp. 84, 85) to the local accumulation of calcium carbonate about fossil wood fragments through ground-water action on the overlying calcareous Jackson beds.

Though no sands are exposed in these outcrops, several sands of considerable thickness have been observed on the surface in Caldwell Parish to the north. Particularly massive sands of the Cockfield are exposed at the town of Columbia, and 2 miles south of Columbia in NE $\frac{1}{4}$ sec. 32, T. 13 N., R. 4 E. Such exposures serve as means of recharge for the water sands of the Cockfield in Grant and LaSalle Parishes.

The Cockfield formation yields highly mineralized water in all of this area except the northern part of LaSalle Parish. Deep tests at Colfax (well G-10), Montgomery (well G-36), and Rochelle (well G-68) have yielded brackish or salty water from this formation. The water from the Colfax well which was examined in the laboratory contained 19,900 parts per million of chloride. The well at Montgomery was reported to have yielded a reddish-colored water testing 616 parts per million of chloride from a depth of 260 feet. The test well at Rochelle was drilled previous to 1905 and abandoned after flowing salt water.

In northern LaSalle Parish, where the Cockfield formation is at or near the surface, wells as deep as 590 feet obtain fresh water from sands in this formation. Samples from seven wells in this area were examined in the laboratory (see tables 3 and 4, wells La-29, La-32, La-36, La-43, La-44, La-46, and La-50). A majority of these samples had a distinct reddish or yellowish tinge which is due for the most part to organic matter in solution. The only two laboratory determinations (see table 4, wells La-36 and La-46) of iron that were made, show 0.10 parts per million and 1.8 parts per million of iron respectively. The chloride content of the samples from the seven wells ranged from 27 parts per million in well La-36 at Urania to 328 parts per million in well La-50 near Standard. The hard-

ness ranged from less than 5 parts per million (well La-29) to 164 parts per million (well La-50). Well La-50 at Standard, however, is very shallow (25 feet) and the higher chloride content and hardness may be due to surface seepage—most of the other samples were low in chloride and were soft. Considerable amounts of sulphate and bicarbonate were found in the samples. The sulphate content ranged from 4 to 470 parts per million and the bicarbonate content, from 349 to 821 parts per million.

Among the minor constituents found in the water from the Cockfield formation was a small amount of fluoride which is associated with the dental defect known as "mottled enamel." (See Chemical character of ground water). All of the water samples, except that from well La-46 at Olla, contained over one part per million. The largest amount, 6 parts per million, was present in the sample from well La-36, which supplies the town of Urania. Samples from wells in Caldwell Parish to the north, have revealed the presence of fluoride in some of the Cockfield sands in that Parish also. The largest amount there was about 3 parts per million, in the water at Grayson.

Jackson group

The term Jackson was applied by Conrad in 1855 (pp. 257-263) to fossiliferous beds near Jackson, Mississippi. The term was used first in Louisiana by Hilgard in 1869 (p. 9) when he utilized it in connection with the outcrops in the general area of Grant and LaSalle Parishes.

The relatively easily eroded sediments of the Jackson group form part of the lowlands which parallel the scarp of the Catahoula sandstone known as the Kisatchie Wold. These materials are found at or near the surface in the northern one-third of Grant Parish and most of the north-western part of LaSalle Parish. The very fossiliferous Jackson group has been subdivided (Hanna, 1934, p. 30) into, in ascending order, the Moody's Branch marl (called Moody's marl by U. S. Geological Survey), Yazoo clay, and the Danville Landing beds.

The Moody's Branch marl consists of very fossiliferous glauconitic sands which grade downward into the lignitic silty clays of the Cockfield formation. This transition zone is from 8 to 12 feet thick at Montgomery Landing where it is well exposed.

The Yazoo clay is composed of fossiliferous, lignitic, and sandy clays with lenticular sands. These have been subdivided and described by Fisk (1938, pp. 98, 100) as follows (from oldest to youngest):

"The Tullos member consists of a series of clays, ranging in thickness from 75 to 175 feet, which are lithologically similar to those described from Yazoo City (Miss.). Clays in fresh exposures have a deep blue-gray color, but upon weathering they change to a drab yellow, or light-gray, eventually breaking down into a black soil.

"The Verda member, the most extensive member of the Jackson group, appears in a great number of exposures in both Grant and LaSalle Parishes. It consists of a series of sparingly fossiliferous, brackish-water, lignitic clays and interbedded silty sands, with intercalated lenticular marine sandstones, fresh-water leaf-bearing silts and marine clays which have an aggregate average thickness of 200 feet."

The Danville Landing beds of Hanna and Gravelle are composed of interbedded sands and clays about 40 feet in total thickness. These beds grade upward into the overlying Vicksburg group and downward into the Yazoo clay.

Very few wells in Grant and LaSalle Parishes have been completed in the sediments of the Jackson group, as only small quantities of bad-tasting water have been found. These wells, ranging in depth from 15 to 35 feet, often go dry in the summer and become turbid in rainy weather, indicating that most of the water is obtained by direct seepage from the surface. Some of this water is highly colored due to organic matter. The results of the

preliminary examination of water from well G-59 (see table 3) show the character of the water from one of the shallow wells penetrating the Jackson group. Brackish water has been reported in the deeper wells.

Oligocene series

Vicksburg group

The name Vicksburg was originally used by Conrad in 1846 (pp. 209, 210) to designate certain fossiliferous exposures at Vicksburg, Mississippi. Hilgard (1869, p. 8) and Hopkins (1871) reported the presence of Vicksburg beds in the region of Grant and LaSalle Parishes.

The sediments of the Vicksburg group which crop out in central Grant and LaSalle Parishes consist of lenticular sands and sandy, thin fossiliferous limestones, and lignitic and gypsiferous shales with a total thickness of 200-300 feet (Fisk, personal communication). Due to the non-resistant character of these beds, most of the outcrops are poorly exposed and occupy the lowlands paralleling the Kitchie Wold. The relationship of this group with the overlying Catahoula formation has long been a basis of disagreement by Gulf Coast geologists (Hilgard, 1881, p. 58; Harris, 1899; Matson, 1916A, pp. 222, 223; Howe, 1933, pp. 633, 634; Chawner, 1936, p. 132). The most recent report (Fisk, 1938, p. 129) on this area, however, shows that the Vicksburg beds are present as far west in the State as the Red River and supports the contention of a transitional and conformable contact with the Catahoula formation.

The sediments of the Vicksburg group as a whole are relatively impermeable and yield only small amounts of water of inferior quality. In the deeper wells this water is usually brackish. The water from the one well (G-56) that was sampled was acid. The sulphate and iron content in this water were 1200 and 43 parts per million respectively, both of which are high concentrations.

Miocene series

Catahoula formation

The sandstones above the Vicksburg were first described by Wailes (1854, pp. 216-219) in Mississippi under the name of Grand Gulf sandstones. Later Hilgard (1860, pp. 147-154) applied the name of Grand Gulf group to the beds exposed in southern Mississippi between the Vicksburg and Pleistocene sediments. This terminology was used with various meanings until Veatch (1906A, p. 84; 1906B, pp. 84, 85, 90) proposed the name Catahoula for the upper

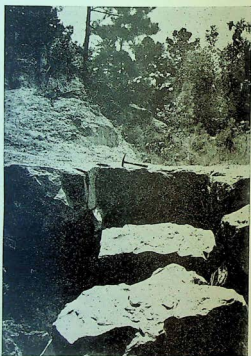


Figure 10—Outcrop of a massive Catahoula sandstone in sec. 30, T. 6 N., R. 2 W., Grant Parish.

sandstones of Hilgard's Grand Gulf group. Veatch regarded the Catahoula as Oligocene in age and was followed by Matson and others until the Tampa limestone, considered the Catahoula equivalent in Florida (Maury, 1902, p. 70; Matson, 1916B, pp. 209-226), was referred to the Miocene series by Cooke and Mossom (1928, pp. 78-93).

The outcrop of the Catahoula formation (see fig. 10) forms the line of hills across Louisiana termed the Kisatchie Wold by Veatch (1906A, p. 39; 1906B, pp. 42, 43). These hills occupy the southern portion of Grant Parish and the southeastern part of LaSalle Parish. The lithology of the Catahoula formation has been well described by Matson (1916B, p. 226).

"The Catahoula sandstone consists of alternating sandstones and sands, with lenticular beds of clay, the arenaceous sediments predominating. Conglomerates are rare, though small quartz and chert pebbles occur in some of the layers of sand, and pebbles of clay are found at many localities and at different stratigraphic horizons. The formation is non-marine, but deposited near the strand line, where small bodies of brackish water were isolated and, on evaporation, formed precipitates of salt and gypsum. The streams that transported the materials now constituting the formation had varying velocities and made deposits ranging in texture from clay to fine-grained conglomerates. The floods that transported the coarse materials eroded the surfaces of existing clay deposits, thus forming irregular contacts and incorporating more or less rounded fragments of the clay in the sands. The fossils, which are rare, are mostly leaves, but molluscan remains occur at a few places."

Volcanic glass shards have been observed in this formation by several writers (Howe, 1933, pp. 637, 639; Chawner, 1936, p. 125; Fisk, 1938, pp. 145-149). This tuffaceous material is perhaps most evident in the matrix of some of the quartzitic sandstones in the lower part of

the formation. Beds of reworked bentonite are present in Sabine Parish where they are being mined for drilling mud.

The Catahoula formation is one of the most important sources of water in Louisiana. The sands are fairly persistent, as shown by the flowing wells along the Red River, but vary considerably in thickness and permeability. The lower sands of the Catahoula often contain more highly mineralized water than those higher in the section. Such is the case of the sands in wells G-12, G-14, G-27, G-64, G-80, G-81, G-83, and G-94, in southwestern Grant Parish and well La-58 at Jena in central LaSalle Parish. Very few deep wells have penetrated the Catahoula formation in LaSalle Parish, and not over twenty in Grant Parish; principally because good water, in quantities sufficient for farm needs, is available at shallower depths from the upland Pleistocene sand and gravel overlying the Catahoula formation.

Samples from 12 deep wells which yield water from Catahoula sands ranged from 6 to 138 parts per million in hardness and from 6 to 1225 parts per million in chloride content (see table 3, wells G-2, G-3, G-5, G-8, G-12, G-13, G-14, G-21, G-27, G-64, G-65, and La-58). The waters in which the chloride content was high (more than 600 parts per million) came from wells G-12, G-14, and G-64 near Colfax, and well La-58 at Jena, all of which penetrate the basal sands of the Catahoula. Most of the remainder, except for G-27 (310 parts per million), contained only small amounts of chloride. The bicarbonate content of the waters is moderate, ranging from 201 to 316 parts per million.

Natural softening of the water in the Miocene sands by base exchange was suggested by the softness of the water in general and by the large amounts of sodium and bicarbonate found in water samples. No determinations of sodium were made on water samples from the Miocene (Catahoula) sands in Grant and LaSalle Parishes, but relatively large amounts of sodium were reported in water from Miocene sands of Rapides Parish (Maher, 1940). Natural softening takes place when ground water comes

in contact with silicates which give up sodium in exchange for calcium and magnesium dissolved in the water. This natural reaction has been reported in several parts of the Atlantic and Gulf Coastal Plain (Howard, 1928, pp. 42, 43; Foster, 1937, pp. 405-412; 1938, p. 1949). The various layers of volcanic ash and numerous sands having a matrix of bentonitic material which are scattered throughout the Catahoula formation may be responsible for this natural softening. Renick (1925, p. 68) in discussing base exchange in ground water, says:

"Bentonite, though containing more than one mineral, always, consists chiefly of micaceous clay minerals which includes the mineral commonly known as leverrierite. This group possesses the property of readily exchanging its bases and is considerably more reactive than the ordinary natural clays.

"It is not intended to convey the idea that the hard near-surface ground water is softened by direct downward percolation through a given number of feet of these leverrierite-bearing strata, because most of the deeper soft water has moved laterally through many feet and even miles, and it is impossible to say just how necessary or important this lateral movement may be. But owing to the facts that these reactions between dissolved salts and base-exchange silicates are rapid and the exchange has been accomplished in all waters beyond a given depth, the conclusion seems justified that ground water will have its calcium and magnesium essentially removed by percolating through relatively few feet of rock containing leverrierite."

The brackish character of water from the basal Catahoula sands in wells G-12, G-14, and G-64 near Colfax, and well La-58 at Jena suggests that these sands contained salt water at the time of their deposition and have been only partly flushed out by ground water. The high mineral content of the water in well La-58 at Jena (total depth 386 feet), which is only about six miles south of the out-

crop of the basal Catahoula sands, indicates that any fresh water in these sands must be limited to a very narrow area in and directly adjacent to the recharge area. The same conditions exist in the Red River Valley in western Grant Parish, where brackish water is found in wells near the outcrop of the basal portion of the Catahoula formation. Deep tests at Alexandria (in Rapides Parish) which penetrate the basal Catahoula sands at depths of 1400 to 1800 feet have yielded salty water showing the dilution to be less complete down the dip of the sands.

Pleistocene and Recent series

The older formation in Grant and LaSalle Parishes are blanketed, in general, with sands, gravels, and clays of Pleistocene and Recent age. The Pleistocene deposits have recently been separated into four formations by Fisk (1940, p. 175), the youngest of which is found in the lowlands along the main streams and tributaries. The deposits which he includes in the three oldest terraces are found at the higher elevations and are the approximate equivalent of the materials formerly referred to the Citronelle formation of Pliocene age. Inasmuch as the quality of the water found in the Pleistocene sediments in the uplands is very different from that in the lowlands, the distribution of the upland Pleistocene deposits and the lowland Pleistocene and Recent alluvium is shown separately in plate 1 and discussed separately in the text.

The name Citronelle formation was applied by Matson (1916A, pp. 167-192) to the upland sands, gravels, and clays which were earlier named Lafayette formation by Hilgard (1891, p. 130). The age of the formation was considered to be Pliocene until Howe (1933, pp. 648-655) questioned this classification in 1933, and Chawner (1936, pp. 136-137) assigned the deposits in Catahoula Parish to the Pleistocene series. In 1938, Fisk (pp. 149-172) included the formation in a series of Pleistocene terrace deposits.

Matson (1916A, pp. 173-175) described the upland sands and gravels now referred to the Pleistocene as follows:

"The Citronelle formation is predominantly sandy but contains varying amounts of clay in the form of thin layers or lenses. The relative proportion of materials of different kinds varies from place to place, and in any one section it varies from top to bottom, though in general sand is every where abundant and at many places there is some gravel. . . .

"The sands of the Citronelle formation are sufficiently rounded to indicate that they have been subjected to extensive attrition. The pebbles vary greatly in degree of rounding; many of them are much water-worn and resemble pebbles found on the beach, others are only slightly rounded, and still others are sub-angular. The sand is predominantly quartz, and the pebbles in the Mississippi embayment are mostly chert, with a somewhat smaller percentage of crystalline quartz and quartzite. Many of the chert pebbles contain cavities lined with chalcedony in the form of agates or geodes, and large numbers of them are fossiliferous, containing fragments of corals, crinoid stems and other organic remains such as are common in the Paleozoic limestones and chert. . . .

"The clays vary greatly in character, some of the beds being relatively pure and others distinctively sandy. On the whole the sandy clays predominate, and in many places thin layers of sand are found in the clay beds. . . .

"The texture of the formation in any particular locality depends entirely on the arrangement and relative percentage of the different kinds of materials. In general, the sands form more or less continuous beds containing lenses of pebbles or clay that in some places have considerable horizontal extent and in others are limited to only a few feet. Many clay lenses are only a few feet to a few rods in extent, though in places

they interlock with other lenses lying above and below them, and in that way present the appearance of a continuous bed, unless it is possible to examine a section in detail. In the sands cross-bedding and cross-lamination are the rule rather than the exception, the layers of clay and pebbles in many places being inclined at high angles. Smooth, even bedding is comparatively rare except in the clay lenses."

Upland Pleistocene deposits overlies most of the Catahoula formation in Grant and LaSalle Parishes, ranging



Figure 11—Upland Pleistocene deposits exposed in a gravel pit of the Lutesville Sand and Gravel Company, center sec. 2, T. 6 N., R. 3 W., Grant Parish.

in total thickness from a few feet to more than 120 feet. North of the Catahoula scarp (Kisatchie Wold) in LaSalle Parish, as outlined by Bayou Funny Louis, the occurrence of these materials is essentially fragmentary and irregular. This may be due to the non-resistant character of the underlying Vicksburg and Jackson clays in that area. In Grant Parish, the occurrence of the upland Pleistocene deposits north of the Catahoula outcrop is irregular but somewhat more general as shown by the presence of these sediments covering the Vicksburg and Jackson materials almost entirely in the area between Summerfield, Montgomery, and Verda.

Upland sand and gravel of the Pleistocene (see fig. 11) supply most of the ground water used in this area. Large supplies have been developed from this source at Jena, Trout, Good Pine, Pollock, and Montgomery. The amount of water available, in general, seems to vary from north to south with the thickness of the formation. Small farm wells are usually successful wherever the thickness is not less than 20 feet. Water-table conditions are present in most of the wells, hence the water does not rise in the casing when the sand is penetrated.

The water from the Pleistocene sand and gravel found in the uplands (see pl. 1) is soft and has a low chloride content together with a small total of dissolved solids. The results of chemical examination of samples from wells drawing upon these sediments (see tables 3 and 4, wells G-25, G-29, G-35, G-40, G-45, La-1, La-38, and La-39) showed a range in hardness from 5.9 to 47 parts per million and a range in chloride content from 2.6 to 46 parts per million. The total of dissolved solids ranged from 24 to 171 parts per million in the four samples which were analyzed completely. This water differs from the water of the Cockfield and Catahoula sands in having a much lower content of bicarbonate as well as a smaller total of dissolved solids. The towns of Pollock, Montgomery, Jena, Trout, and Good Pine, as well as most of the farm homes, use this water from the shallow upland sands and gravels.

The flood plains of the major drainages in Grant and LaSalle Parishes are blanketed with silt, clay, and sand with some gravel. The clay, which has a red color typical of the alluvium of the Red River, grades downward into fine sand and then into coarse sands and gravels with interbedded clay. The base of the coarse sand and gravel is often marked by the occurrence of carbonized wood. The thickness of the lowland Pleistocene deposits and Recent alluvium ranges from a few feet to about 130 feet, apparently increasing somewhat southward.

Small domestic supplies of hard water may be obtained from the fine sands of the lowland Pleistocene deposits at depths from 30 to 60 feet. Larger supplies of water, such as that of the town of Colfax, are available from the coarse sand and gravel found between 90 and 130 feet below the surface. Water-table conditions are present in most places. The relatively small development of this source is probably due to the hardness of the water and the relatively large content of iron which produces a disagreeable taste.

Samples of water from the Pleistocene and Recent sediments found in the lowlands (see pl. 1) ranged in hardness from about 100 to over 500 parts per million (see tables 3 and 4, wells G-9, G-16, G-62, G-72, G-73, G-74, G-75, G-76, G-78, G-86, G-87, La-12, La-28, and La-53). The chloride content ranged from about one to over 600 parts per million. The higher amounts of chloride as well as the larger totals of dissolved solids were found in the water from shallow wells in or near Colfax in western Grant Parish. There the lowland Pleistocene is directly underlain by the basal members of the Catahoula formation which contain brackish water. This brackish water has probably contaminated the water in the Pleistocene sands by direct upward seepage under artesian pressure or through leakage into the bottom of some wells which were drilled below the base of the Pleistocene series. This is discussed in detail in the section of this report dealing with the Colfax water supply. The relatively small development of the Pleistocene water sands in the lowlands is probably due to the hardness of the water and the rather large content of iron.

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